

**BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, DC 20554**

Competitive Bidding Procedures and Certain)	AU Docket No. 17-182
Program Requirements for the Connect)	WC Docket No. 10-90
America Fund Phase II Auction (Auction 903))	

**REPLY COMMENTS OF THE AMERICAN CABLE ASSOCIATION
IN RESPONSE TO THE PUBLIC NOTICE**



Matthew M. Polka
President and Chief Executive Officer
American Cable Association
Seven Parkway Center
Suite 755
Pittsburgh, PA 15220
(412) 922-8300

Thomas Cohen
J. Bradford Currier
Kelley Drye & Warren LLP
3050 K Street, NW
Washington, DC 20007
(202) 342-8518
Counsel to American Cable Association

Ross J. Lieberman
Senior Vice President of Government Affairs
American Cable Association
2415 39th Place, NW
Washington, DC 20007
(202) 494-5661

October 18, 2017

TABLE OF CONTENTS

I.	INTRODUCTION AND SUMMARY	1
II.	THE PROPOSED AUCTION DESIGN SHOULD BE MODIFIED TO MAXIMIZE PARTICIPATION, WHICH WILL FACILITATE EFFICIENT OUTCOMES	3
A.	The Auction Design Should Not Allow Package Bidding	5
B.	The Auction Design Should Not Permit Bidders to Shift Performance/Latency Tiers Once Established for a Bidding Area	9
C.	The Auction Design Should Limit Switching Geographic Areas Between Rounds	11
III.	THE PROPOSED FINANCIAL QUALIFICATIONS SHOULD BE AMENDED TO FACILITATE PARTICIPATION WHILE ENSURING INTEGRITY OF THE AUCTION AND COMPLIANCE WITH THE PUBLIC INTEREST AND DEPLOYMENT OBLIGATIONS.....	12
IV.	ANTI-COLLUSION REQUIREMENTS SHOULD ENABLE PROVIDERS TO SHARE AUCTION EXPERTS WHILE PREVENTING PROHIBITED COMMUNICATIONS	17
V.	THE AUCTION, EVEN PRIOR TO THE <i>PUBLIC NOTICE</i> 'S PROPOSALS ON AUCTION DESIGN AND QUALIFICATIONS, INHIBITED PARTICIPATION IN MANY WAYS; ACCORDINGLY, THE COMMISSION SHOULD ACCEPT ACA'S RECOMMENDATIONS ON THE <i>PUBLIC NOTICE</i> 'S PROPOSALS, WHICH WILL HELP ENSURE PARTICIPATION.....	21
	ATTACHMENT	

**BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, DC 20554**

Competitive Bidding Procedures and Certain)	AU Docket No. 17-182
Program Requirements for the Connect)	WC Docket No. 10-90
America Fund Phase II Auction (Auction 903))	

**REPLY COMMENTS OF THE AMERICAN CABLE ASSOCIATION
IN RESPONSE TO THE PUBLIC NOTICE**



I. INTRODUCTION AND SUMMARY

The American Cable Association (“ACA”)¹ hereby provides reply comments in response to the *Public Notice* by the Federal Communications Commission (“Commission”)² on the competitive bidding procedures and certain program requirements for the Connect America Fund Phase II Auction (“Auction”).

The Auction is the Commission’s first effort to use competitive bidding to award fixed line universal service support in unserved areas. That alone should make the Commission proceed carefully to ensure it adopts bidding procedures and program requirements that will maximize participation, thereby increasing the chances the Auction will produce efficient outcomes.

In its initial comments, ACA explained that, because of the inordinate complexity of the proposed Auction design and the undue burdens of the proposed procedures, providers would

¹ ACA represents approximately 750 local providers of broadband Internet access, voice, and video programming services to residential and commercial customers. Many ACA members either abut or are located near areas eligible for the Connect America Fund Phase II Auction or otherwise have expressed interest in participating in the auction.

² *Comment Sought on Competitive Bidding Procedures and Certain Program Requirements for the Connect America Fund Phase II Auction (Auction 903)*, AU Docket No. 17-182, WC Docket No. 10-90, Public Notice, 32 FCC Rcd 6238 (2017) (“*Public Notice*”).

be deterred from participating and, as a result, the Auction would not produce efficient outcomes.³ ACA therefore recommended the Commission at least eliminate package bidding and the ability for a bidder to shift its performance/latency tier once established in its initial bid.⁴ ACA also urged the Commission rethink its proposed additional “five-point” financial screen, which it submitted would not indicate whether an experienced provider has sufficient financial capability to perform if it was winning bidder.⁵ ACA further addressed the need of small providers to share consultants without violating the Commission’s anti-collusion rules.⁶ It proposed that participants sharing consultants establish written procedures identifying specific types of prohibited communications, share these procedures with all individuals involved in the bidding, and provide them to the Commission upon request.⁷

In these reply comments, ACA builds on those recommendations, informed by the comments filed by other parties and the recommendations provided in the attached paper by Professor Peter Cramton, a recognized auction expert who ACA retained to evaluate the Commission’s proposed Auction design and procedures.⁸ As a result, ACA proposes that the Commission: (1) prohibit package bidding and tier shifting between rounds, but adopt its Activity Rule proposal to limit “switching” of areas between rounds to a 10 percent “switching percentage”; (2) reject the proposed “five-point” financial screen; and (3) enable bidders to share auction experts without violating the Commission’s anti-collusion requirements.

³ Comments of the American Cable Association in Response to the Public Notice, AU Docket No. 17-182, WC Docket No. 10-90, at 7 (Sept. 18, 2017) (“ACA Comments”). While ACA is concerned about the Auction design and other proposals in the *Public Notice*, it commends the Commission and staff on its willingness to educate potential bidders about the Auction so as to encourage their participation. See *Public Notice*, 32 FCC Rcd at 6259-60, para. 71.

⁴ ACA Comments at 7.

⁵ *Id.* at 8.

⁶ *Id.* at 7-8.

⁷ *Id.*

⁸ See Peter Cramton, “On the Design of the Connect America Fund Phase II Auction” (Oct. 18, 2017) (“Cramton”).

II. THE PROPOSED AUCTION DESIGN SHOULD BE MODIFIED TO MAXIMIZE PARTICIPATION, WHICH WILL FACILITATE EFFICIENT OUTCOMES

The *Public Notice* proposes that the Auction use a descending clock to identify providers and a “second-price” rule to establish the amount of support.⁹ Professor Cramton explains that a straightforward descending clock auction gets high marks for achieving important objectives, such as price discovery, transparency, fairness, and efficiency.¹⁰ He endorses the Commission’s use of such an auction.¹¹ However, he then adds that because the *Public Notice* proposes to add much more complexity to this design (e.g., package bidding), which will discourage participation, it effectively undermines the achievement of its objectives and would enable bidders to win at prices above efficient levels.¹²

ACA is not alone in its criticism of the Auction design’s complexity. WISPA, for instance, commented that the proposed design “is likely to discourage some potential bidders from

⁹ *Public Notice*, 32 FCC Rcd at 6259-60, para. 71.

¹⁰ See Cramton at 8-9 (stating that a descending clock auction “gets high marks with respect to all four objectives. First, the auction is a simple price discovery process. Bidding strategy amounts to estimating the cost of providing service and then exiting when this cost is reached. Second, the auction is highly transparent. The rules are clear and it is easy to see why a bidder won or lost at a price Third, the auction is fair. Every potential bidder faces the same rules and all trade takes place at the market-determined clearing price. And finally, the auction is efficient. Given the straightforward and effective bidding strategy of exiting when cost is reached, the auction is fully efficient, maximizing total surplus.”).

¹¹ See *id.* at 12 (“[W]e agree with the FCC that it should use a descending clock auction.”). Professor Cramton also advocates for the use of intraround bidding, noting that the Commission proposed allowing bidders to submit an exit bid at any price point percentage between the current and previous base clock percentage. *Id.* at 13-14.

¹² See *id.* at 16 (concluding that “the excessively complex design would adversely limit competition among participants, which would undermine the goal of a competitive auction and an efficient outcome”). ACA notes that, even prior to submitting comments in this proceeding, it filed a joint letter with WISPA and NTCA warning the Commission that “the auction design and associated proposals in the *Public Notice*, especially when taken in aggregate, are so inordinately complex that they will deter many potential bidders from participating.” Letter from Ross Lieberman, Senior Vice President, ACA *et al.*, to Chairman Ajit Pai, FCC *et al.*, AU Docket No. 17-182, WC Docket No. 10-90, at 1 (Sep. 18, 2017) (“*Lieberman Ex Parte*”). ACA appreciates that, in certain aspects, the *Public Notice* recognizes the need for greater simplicity in the auction design. For example, the *Public Notice* proposes prohibiting a bidder from placing more than one bid for a given geographic area in a round. *Public Notice*, 32 FCC Rcd at 6263, para. 86. The *Public Notice* explains this “will simplify bid strategies for bidders.” *Id.* It also would reduce opportunities for coordinated bidding “that may disadvantage other bidders.” *Id.*

participating, particularly smaller providers.”¹³ The Rural Coalition noted that the Auction “will be extremely complex” and urged “the Commission at every turn to consider ways to simplify the Auction design in a manner that will enable small businesses to participate meaningfully without undermining the process by which support can be distributed at efficient levels.”¹⁴ United States Cellular Corporation added that “in the context of reverse auctions for universal service support, the Commission should strive for an auction design that emphasizes simplicity rather than complexity” to attract small players.¹⁵

To address this concern, ACA in its initial comments recommended the Commission eliminate package bidding and prohibit bidders from shifting performance/latency tiers after establishing them.¹⁶ Professor Cramton echoes these recommendations, noting that the clock auction still enables bidders to target desirable service areas without the complexity and bias presented by package bidding, and avoids the potential for gamesmanship through tier bid shifting that would undermine price discovery.¹⁷ ACA discusses the detriments of package bidding and tier bid shifting below. ACA also reviews the proposed Activity Rule to limit “switching” of areas between rounds, including the proposal to adopt a 10 percent switching percentage, and believes this proposal will reduce complexity and facilitate participation at little cost to drive more efficient outcomes.¹⁸

¹³ Comments of the Wireless Internet Service Providers Association, AU Docket No. 17-182, WC Docket No. 10-90, at 27 (Sept. 18, 2017) (“WISPA Comments”).

¹⁴ Comments of the Rural Coalition, AU Docket No. 17-182, WC Docket No. 10-90, at 7 (Sept. 18, 2017) (“Rural Coalition Comments”).

¹⁵ Comments of United States Cellular Corporation, AU Docket No. 17-182, WC Docket No. 10-90, at 11 (Sept. 18, 2017) (“US Cellular Comments”).

¹⁶ ACA Comments at 7.

¹⁷ Cramton at 16.

¹⁸ As Professor Cramton emphasizes, “[g]etting the auction design right is especially important given the high level of inertia in almost all government programs. The design that is used here could realistically be anticipated to be the design that is used in future years.” *Id.* at 4. The Commission therefore should carefully reconsider the Auction procedures and modify them to encourage broader provider participation.

A. The Auction Design Should Not Allow Package Bidding

The Commission proposed package bidding for the Auction in the *2014 Connect America Fund* Further Notice of Proposed Rulemaking, concluding summarily that “such package bidding is likely necessary so that bidders may construct efficient networks and are not left to serve certain high-cost tracts without the scale to do so effectively.”¹⁹ In the *2016 Phase II Auction Order*, the Commission announced that the “Auction Comment PN will seek comment on other auction procedures . . . such as . . . package bidding,” but provided no further explanation as to whether the benefits of package bidding outweighed the costs.²⁰ The *Public Notice*, without first asking whether package bidding is warranted, inquires about the proposed package bidding format and whether this format would facilitate bids for “areas with diverse costs, population densities, and other characteristics,” and would be useful to both bidders with small networks and those with large networks.²¹ In sum, nowhere has the Commission undertaken any cost-benefit analysis about whether package bidding would in fact maximize participation and efficient bidding in the Auction, thereby serving the public interest. If it had done so, it would have rejected using this mechanism.

To begin with, package bidding is far less likely to be of value in the Auction – or at least any value is outweighed by the added design complexity – because in the Auction the lots are far less likely to be substitutable or complementary for most bidders.²² For instance, unlike in a spectrum auction to provide mobile services, potential bidders in the Auction will be using

¹⁹ *Connect America Fund et al.*, WC Docket No. 10-90 *et al.*, Report and Order, Declaratory Ruling, Order, Memorandum Opinion and Order, Seventh Order on Reconsideration, and Further Notice of Proposed Rulemaking, 29 FCC Rcd 7051, 7125, para. 228 (2014).

²⁰ *Connect America Fund et al.*, WC Docket No. 10-90 *et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 5949, 6021, para. 205 (2016) (“*Phase II Auction Order*”).

²¹ *Public Notice*, 32 FCC Rcd at 6264, para. 93.

²² See Cramton at 5 (stating that the Auction “differs from spectrum auctions in that for most bidders each lot may not be fungible with other lots around the country, particularly for smaller wireline providers”); see also *id.* at 3 (warning that “[s]ubstitution across service areas and technologies is limited by each bidder’s existing infrastructure and technological expertise”).

different technologies with far different cost characteristics, many of which can be efficiently deployed without covering extensive areas or contiguous eligible areas. In addition, many potential bidders will have existing network infrastructure either in the eligible areas or near to the eligible areas, which may be deployed efficiently (*i.e.*, do not require substantial economies of scale and scope). This means that any supposed efficiencies from “packages” are limited at best and illusory at worst. To demonstrate this most simply, a rural telephone company in Texas will have no interest in bidding for a lot in Maine or even on the other side of Texas. As in real estate, for many bidders like a wireline rural provider what counts is “location, location, location.” They can bid most efficiently for areas where they can extend their existing networks.²³ An incumbent price cap carrier is likely to have somewhat similar economic incentives, because it already has network facilities in the eligible areas and likely in the areas surrounding them. That incumbent then can bid on a potentially larger, albeit still limited scale, based on the location of its wire center and other points of aggregation.²⁴ Perhaps only a satellite provider with an existing satellite capable of serving large areas will view lots in many different areas to be substitutable and complementary.²⁵ Thus, in the Auction, many, if not most, bidders will be seeking to serve only a limited area, which they may be able to do just as, if not more, efficiently than a provider seeking to serve a larger area.

²³ ACA supports the *Public Notice*’s proposal to use a census block group as the minimum geographic area for bidding. *Public Notice*, 32 FCC Rcd at 6263, para. 85. From discussions with its members, ACA has determined that wireline providers that are abutting or near to an eligible area will find it reasonably efficient to extend their networks to serve eligible locations by census block group. See Cramton at 5 (“In general, wireline providers, to achieve economies of scale, will bid near where they have existing facilities The small cable operator, which is unlikely to have any facilities in any eligible area, will bid in abutting areas.”).

²⁴ However, the Commission should not expect an incumbent carrier outside its territory to bid against another incumbent, which means they are not likely to provide packages within a state that include other incumbents’ eligible areas. See Cramton at 5 (“AT&T may have a greater presence than a small cable operator, but it is most likely to bid where it already provides service.”).

²⁵ See *id.* (noting that satellite providers can examine the market on a nationwide basis).

As for the costs of package bidding, entities bidding on limited areas will find they are “playing a different game” against package bidders, who may be able to maintain inefficiently high bids in areas that are part of their package where they are the sole bidders and excessively low bids where they face challengers – and who, at least, will have a greater opportunity to “game” their bids. In the end, smaller entities may conclude that this added complexity places them at a disadvantage and will be dissuaded from participating in the Auction.

ACA’s concerns about package bidding also were raised by United States Cellular Corporation, which urged the Commission to refrain from adopting package bidding for the Auction.²⁶ It explained that package bidding would add “considerable complexity to the Auction 903 bidding processes,” because it “drastically increases the number of bid possibilities” and increases the length of the Auction.²⁷ As a result, it would most likely be used only by larger carriers, who would spend substantial resources to fashion and support through sophisticated bidding strategies elaborate package bids on a statewide basis. By contrast, smaller providers that seek to bid for a limited area could not justify expending the same resources or in fact are unlikely to have the deep-pockets to provide them.²⁸ Knowing this, smaller providers would not participate, and larger carriers would prevail in the bidding without reducing bids to efficient levels.²⁹ Professor Cramton notes that prohibiting package bidding “avoids gaming strategies

²⁶ US Cellular Comments at 5.

²⁷ *Id.* at 5, 10. United States Cellular Corporation also noted that the Commission decided not to use package bidding in the 600 MHz forward auction because of the additional complexity it would introduce. *Id.* at 9.

²⁸ *Id.* at 7 (“A further problem is that smaller carriers typically lack the resources needed to directly compete for funding by making package bids. In addition, given their interest in receiving support for targeted areas, smaller carriers may lack any incentive to compete for funding based on package bids.”). See Cramton at 11 (asserting that “one bidder may be willing to provide a service over one large area; whereas, other bidders may only want to provide service in a portion of this space. Each bidder likely has its own view on the optimum projects and these projects likely depend on the bidder’s existing infrastructure and technologies”).

²⁹ United States Cellular Corporation also raised the concern that “package bidding could have the effect of significantly delaying advanced broadband deployment in sparsely populated rural areas.” US Cellular Comments at 8.

that favor the largest and most sophisticated bidders” and requires such bidders to make room for smaller competitors.³⁰ By contrast, allowing package bidding at the Auction will result in “fewer bidders, fewer winners, and less creation of social welfare.”³¹ As a result, Professor Cramton finds that “the clock auction gives bidders ample opportunity to piece together a desirable package of areas, without the complexity and bias inherent in a package auction.”³²

USTelecom, by contrast, supported package bidding, arguing that it reflects the complexity of how networks are constructed and operated.³³ USTelecom, however, provides no evidence that its “network complexity” argument would apply to all or most bidders, or even to incumbent price cap carrier bidders in all circumstances, and it would have difficulty doing so for at least two reasons. First, bidders in the Auction can employ a variety of network technologies with different engineering and cost characteristics and, as discussed above, they may be able to achieve efficiencies even if deployments are in more limited areas.³⁴ ACA recognizes that an incumbent carrier may in certain instances need to install new electronics at its central office or other point of aggregation, which may serve an area larger than a census block group, but other bidders may not be similarly constrained. For instance, a nearby rural telephone provider or cable operator could extend existing wireline plant to such a limited area, or a fixed wireless provider could install a single transmitter, or a satellite provider with an existing satellite could just initiate marketing. For all of these “other” instances, service could be provided efficiently on a census block group basis. In any event, even without package bidding, nothing in the

³⁰ Cramton at 3-4.

³¹ *Id.* at 4.

³² *Id.* at 16.

³³ Comments of The USTelecom Association, AU Docket No. 17-182, WC Docket No. 10-90, at 5 (Sept. 18, 2017) (“USTelecom Comments”). USTelecom also argued that package bidding would facilitate the distribution of funding to not just the easiest to serve areas. *Id.* USTelecom’s argument, of course, is premised on operating efficiencies for each network technology, and it provided no analysis of how network efficiencies would differ based on different technologies.

³⁴ *Public Notice*, 32 FCC Rcd at 6247, para. 30.

Commission's proposed rules prevents an incumbent carrier from bidding on multiple census block groups that would enable it to deploy its facilities most efficiently.³⁵ Second, even for an incumbent carrier, it is doubtful there are material efficiencies in bidding on a package of areas many miles apart in the same state. In effect, USTelecom would have the Commission adopt a bidding area that reflects its wire center topography and not a neutral geographic area. The Commission rejected that proposal many years ago.³⁶

ACA thus stands by its recommendation in its initial comments; the Auction design should eschew package bidding because it adds complexity, which will limit participation, without producing significant, if any, benefits.

B. The Auction Design Should Not Permit Bidders to Shift Performance/Latency Tiers Once Established for a Bidding Area

The *Public Notice* states, without seeking comment, that before the Auction budget has cleared, a bidder may shift its performance/latency tier "in any of its bids from the previous round."³⁷ The *Public Notice* provides no support for this decision. In theory, if the performance/latency tier weights adopted by the Commission were based on the cost of deploying different technologies, it would make little difference whether a bidder could shift tiers to serve an area between rounds. But the Commission selected weights for the performance/latency tiers based on a variety of factors without reference to cost.³⁸ In effect,

³⁵ Incumbent carriers are concerned that in such a scenario, they may lose bids in more desirable census block groups and win those in the least desirable. But USTelecom claimed that same scenario holds when the minimum scale percentage in package bidding is 80 percent, as the Commission proposes. USTelecom Comments at 6-9. USTelecom sought to address this concern by proposing to raise the minimum scale percentage to 100 percent (an all-or-nothing bid). *Id.* at 7-8. But all-or-nothing package bidding would almost certainly lead to many unserved areas not obtaining service that another bidder could provide economically. *Public Notice*, 32 FCC Rcd at 6264, para. 90.

³⁶ *Connect America Fund et al.*, WC Docket No. 10-90 *et al.*, Report and Order and Further Notice of Proposed Rulemaking, 26 FCC Rcd 17663, 17732, para. 179 (2011) ("[W]e proposed to use census blocks as the minimum geographic unit eligible for competitive bidding.") ("*2011 CAF Order*").

³⁷ *Public Notice*, 32 FCC Rcd at 6263, para. 89.

³⁸ *Phase II Auction Order*, 31 FCC Rcd at 5957, paras. 15-16.

from the outset, the Commission has violated Professor Cramton's maxim that an auction design should "induc[e] truthful bidding . . . [where] bids are based on providers' intrinsic costs of providing service."³⁹ As a result of this decision on how to base weights, a bidder will have greater difficulty in evaluating the validity of another entity's bid, particularly when the other entity's bid is a package bid.⁴⁰ Permitting a bidder to shift tiers between rounds makes bidding more opaque and especially difficult for smaller providers to evaluate, effectively violating another of Professor Cramton's maxims: encourage outcome discovery.⁴¹ As Professor Cramton notes, it is unlikely that an individual bidder in the Auction will have a meaningful trade-off in performance/latency tiers.⁴² Allowing tier shifting therefore provides "an effective instrument for gaming" for a larger, sophisticated bidder that may, as part of a package bid, "park using a low-weight performance tier and latency combination or misrepresent the combination to gain advantage over competing bidders."⁴³ Professor Cramton further notes that, because providers will design their Auction bidding strategies according to business plans based on specific performance/latency tier combinations, "there is little gained but complexity and gaming from allowing [tier-shifting] flexibility throughout the auction."⁴⁴ Consequently, prohibiting bidders from shifting performance/latency tiers "avoids complex gaming strategies that would otherwise undermine price discovery."⁴⁵

³⁹ Cramton at 5.

⁴⁰ See *id.* at 7 (noting that simpler auction designs tend to avoid such guesswork).

⁴¹ See *id.* at 5-6 (stating the Auction procedures should "encourage bidders to truthfully express preferences throughout the entire auction. This truthful expression of preferences is what leads to improved outcomes from better outcome discovery during the bidding process."); see also *id.* at 14 ("[A]llowing greater flexibility in switching encourages substitution but also enables parking strategies that undermine outcome discovery; whereas, allowing little flexibility in switching encourages outcome discovery by preventing parking.").

⁴² *Id.* at 4.

⁴³ *Id.* at 13.

⁴⁴ *Id.*

⁴⁵ *Id.* at 16.

In addition to these issues, by permitting bidders to shift performance/latency tiers between rounds, the *Public Notice* would skew the Auction in favor of larger providers for two reasons. First, larger providers are more likely to have the resources to develop different business plans based on technologies capable of meeting different tier thresholds for a single lot and shift between tiers between rounds. Smaller providers, by contrast, are unlikely to be able to incur such significant upfront costs and, believing they are disadvantaged, will be more reluctant to participate. Second, larger providers, again because of their “deeper pockets,” will have greater ability to develop sophisticated bidding strategies around the use of different performance/latency tiers, which will undermine outcome discovery. With less outcome discovery, smaller bidders will find it more difficult to evaluate the validity of competing bids, discouraging participation.

C. The Auction Design Should Limit Switching Geographic Areas Between Rounds

The *Public Notice*, as part of the Activity Rules, proposes to limit a bidder’s ability to bid in different areas from round to round and proposes a 10 percent “switching percentage.”⁴⁶ The aim of this proposal is “to encourage bidders to express their bidding interests early and sincerely.”⁴⁷ ACA believes this proposal will achieve the *Public Notice*’s aim while enhancing the simplicity of the Auction, with little downside, and urges its adoption with the proposed switching percentage.⁴⁸ As Professor Cramton argues, the switching percentage and strengthened Activity Rules combat parking strategies that would otherwise compromise

⁴⁶ *Public Notice*, 32 FCC Rcd at 6266, para. 99.

⁴⁷ *Id.* at 6265, para. 98.

⁴⁸ ACA recognizes that permitting limited switching among geographic areas is beneficial in many circumstances and agrees with Professor Cramton’s warning that prohibiting switching creates “a potential coordination problem if too many limited bidders initially select the same lots and leave other desirable lots unbid.” Cramton at 13.

outcome discovery and reduce the efficiency of the Auction.⁴⁹ Not only is bidding simplified under the switching percentage and Activity Rules, but bids “are more apt to reflect true costs.”⁵⁰

ACA notes that USTelecom sought a much higher switching percentage that would be reduced as the rounds progressed, thus enable bidders to jump in and out of a large number of areas initially.⁵¹ USTelecom argued that its approach would “capture the tradeoffs presented by switching – between price discovery, truthful bidding, and substitution – in a more sophisticated fashion.”⁵² ACA appreciates USTelecom’s desire to drive more efficient results, but its proposal would turn the auction into more of an endurance test, which would tax the resources of smaller providers. In addition, as discussed above, the lots in the Auction are not likely to be substitutable or complementary, and thus the value of enabling greater switching is more limited.

III. THE PROPOSED FINANCIAL QUALIFICATIONS SHOULD BE AMENDED TO FACILITATE PARTICIPATION WHILE ENSURING INTEGRITY OF THE AUCTION AND COMPLIANCE WITH THE PUBLIC INTEREST AND DEPLOYMENT OBLIGATIONS

In the *Phase II Auction Order*, the Commission adopted “alternative prequalification requirements” for entities that had operated a network for at least two years, since this would give the Commission “sufficient assurance before the auction that an entity has at a minimum level demonstrated that it has the ability to build and maintain a network.”⁵³ Then, “to ensure that every Phase II auction recipient is in good financial health,” the Commission required these experienced applicants either to supply audited financial statements with the short form application or, if they do not keep such statements in the ordinary course of business, to supply

⁴⁹ *Id.* at 3, 15-16. See *id.* at 15 (stating that increased switching among lots “may distort bidding and discourage outcome discovery, especially if it is difficult for the regulator to estimate relative costs across lots”).

⁵⁰ *Id.* at 16.

⁵¹ USTelecom Comments at 9-11.

⁵² *Id.* at 10.

⁵³ *Phase II Auction Order*, 31 FCC Rcd at 5983, para. 100.

audited financials if they are selected as the winning bidder.⁵⁴ The Commission required non-experienced applicants to supply more extensive financial information.⁵⁵ In the *Public Notice*, the Commission proposes, based on its “experience with the rural broadband experiments,” to impose an additional financial screen – a “five-point” scale – which it asserts “should help Commission staff evaluate, quickly and efficiently, an applicant’s financial qualifications.”⁵⁶ Should an applicant not score high enough on the scale, Commission staff would undertake a “more in-depth review of the full set of financial statements,” although no metric for such review is provided in the *Public Notice*.⁵⁷ In addition, the *Public Notice* emphasizes that any determination at the short-form application stage would not “preclude a determination at the long-form application review stage that any applicant is not authorized to receive Phase II support.”⁵⁸

ACA was joined by many other commenters in questioning the utility and validity of the proposed “five-point” scale as an indicator of an applicant’s financial capabilities.⁵⁹ WISPA in fact called for the Commission to “reject this approach *in its entirety*” because it would hold auction participants to a higher standard than the Commission applied to price cap carriers who elected model-based support, would penalize providers that were expending capital rather than husbanding cash, and would disadvantage non-public entities that have unique capital

⁵⁴ 47 CFR 54.315(a)(7)(i); *Phase II Auction Order*, 31 FCC Rcd at 5982-84, paras. 100-102. For experienced providers that do not have audited financials, the Commission explained, “[b]ecause such entities will be required to demonstrate that they have provided a voice, broadband, or electric distribution or transmission service for two years, we conclude that will give us reasonable assurance of an entity’s financial health for permitting that entity to participate in the auction.” *Id.* at 5984, para. 102. While the Commission gave these experienced providers leeway in submitting audited financials with the short-form application, it required them, should they win, to submit audited financials with their proof of ETC designation, and it adopted significant forfeitures if audited financials were not provided. *Id.* at 5984-85, paras. 103-04.

⁵⁵ 47 CFR 54.315(a)(7)(i); *Phase II Auction Order*, 31 FCC Rcd at 5985, para. 106.

⁵⁶ *Public Notice*, 32 FCC Rcd at 6256, para. 58.

⁵⁷ *Id.*

⁵⁸ *Id.* at 6257, para. 61.

⁵⁹ ACA Comments at 8.

structures.⁶⁰ WISPA further noted that because of these flaws, the “five-point” scale would not lead to the Commission making quick and efficient evaluations, but rather result in it having to undertake more in-depth reviews.⁶¹ WISPA instead proposed the Commission conduct additional analysis of an applicant’s financial wherewithal only where the applicant’s EBITDA margin is below 10 percent.⁶²

While WISPA’s concern was that the test would be inappropriate for smaller providers, both USTelecom and ITTA asserted it was unwarranted for larger, experienced broadband providers and would unnecessarily burden them.⁶³ They noted the Commission did not consider this screening mechanism (or any additional in-depth review) necessary for the award of model-based support, and there was no reason to change course here. ITTA believed the Commission should deem an applicant is financially qualified if it submits audited financials from the prior fiscal year that received an unmodified, non-qualified opinion from the auditor.⁶⁴ USTelecom proposed that if the Commission wants additional examination beyond financials, it

⁶⁰ WISPA Comments at 21-24 (emphasis in original). WISPA’s analysis showed that “at least three price cap carriers would not achieve a score of three . . . and no price cap carrier would achieve a score above three.” *Id.* at 21-22. BEK Communications, a smaller provider operating in North Dakota, made a similar point in its comments: “BEK does not believe that having a current ratio of less than two is an indication that an applicant is in poor financial shape – if anything, it is an indication that the company is utilizing its cash to fund broadband deployment and network upgrades and expansion [I]t will be difficult for small broadband providers to show a current ratio of at least two, unless the applicant is essentially sitting on its cash reserves.” Comments of BEK Communications, WC Docket No. 10-90, AU Docket No. 17-182, at 2 (Sept. 18, 2017).

⁶¹ WISPA Comments at 22.

⁶² *Id.* at 24.

⁶³ Comments of ITTA—The Voice of America’s Broadband Providers, WC Docket No. 10-90, AU Docket No. 17-182, at 1-4 (Sept. 18, 2017) (“ITTA Comments”); USTelecom Comments at 2-5. USTelecom, for instance, contended that the last three metrics in the proposed test “are merely financial ratios of an applicant company and provide no insight into the applicant’s size and scale of operations and whether it has the financial resources to take on CAF Phase II obligations.” USTelecom Comments at 4.

⁶⁴ ITTA Comments at 5.

should focus on an applicants' GAAP operating cash flow, which would indicate that a company can generate sufficient cash flow to operate and grow.⁶⁵

While ACA did not reject the "five-point" scale out of hand in its initial comments, it now urges the Commission to do so, at least for experienced applicants, for many reasons. First, for experienced applicants, who have been providing service for at least two years, the screen is unnecessary.⁶⁶ These experienced applicants have a track record in providing service and have obligations to shareholders, creditors, and their franchising authorities and regulators. In the *Public Notice*, the Commission does not cite any evidence to indicate it should be concerned about the ability of these experienced applicants to perform. Moreover, the Commission, in effect, seems to have reached this same conclusion that experience is a sufficient indicator without the "five-point" scale when it did not use such a financial screen (or any additional screen for that matter) prior to awarding model-based support to price cap carriers.⁶⁷ In

⁶⁵ USTelecom Comments at 4-5.

⁶⁶ The Commission seems to have agreed to this conclusion in the *Phase II Auction Order* since it proposed just the submission of financial statements and no additional financial screen for such applicants. *Phase II Auction Order*, 31 FCC Rcd at 5983, para. 101.

⁶⁷ See *2011 CAF Order*, 26 FCC Rcd at 17715-17, paras. 132-36. Some price cap carriers are viewed by market ratings firms or analysts as financially challenged. Over the past year, financial concerns have been raised about Frontier Communications and Windstream Communications. See, e.g., Moody's Investors Service, "Rating Action: Moody's downgrades Frontier to B2, outlook remains negative" (May 22, 2017), available at https://www.moody.com/research/Moodys-downgrades-Frontier-to-B2-outlook-remains-negative--PR_367047; Moody's Investors Service, "Rating Action: Moody's changes Windstream's outlook to negative" (Mar. 27, 2017), available at https://www.moody.com/research/Moodys-changes-Windstreams-outlook-to-negative--PR_364185. Further, FairPoint Communications filed for bankruptcy in 2009 and emerged in 2011. Consolidated Communications acquired FairPoint Communications on July 3, 2017. In its Safe Harbor statement filed with the Securities and Exchange Commission upon close of the transaction, Consolidated Communications stated "[t]hese forward-looking statements reflect, among other things, our current expectations, plans, strategies, and anticipated financial results. There are a number of risks, uncertainties, and conditions that may cause our actual results to differ materially from those expressed or implied by these forward-looking statements. These risks and uncertainties include our ability to successfully integrate FairPoint Communications, Inc.'s operations and realize the synergies from the integration, as well as a number of factors related to our business." Consolidated Communications, "Consolidated Communications Completes FairPoint Acquisition" (July 3, 2017), available at <https://globenewswire.com/news-release/2017/07/03/1038532/0/en/Consolidated-Communications-Completes-FairPoint-Acquisition.html>.

addition, the Commission's sole rationale for proposing the screen is based on "experience" with the rural broadband experiments, but it offers no information to indicate that experienced providers were the cause of any financial qualifications concerns.⁶⁸

Second, as the above commenters demonstrated, the screen is not a valid indicator as to whether an applicant is financially qualified for purposes of meeting the public interest requirements and deployment obligations should it be a winning bidder.⁶⁹ This is particularly the case for smaller providers that may be entering a heavy investment cycle, which may occur every five to ten years, and so is keeping little cash on hand.

Third, should a provider not pass the screen, it faces "in-depth" review by Commission staff, but the Commission has provided no test or standard for such review. This will lead to uncertainty for applicants, dissuading them from participating in the auction.

Fourth, the Commission has already noted that it will address financial qualifications further in the long-form application and may disqualify a winning bidder should it deem the provider to be unqualified. The Commission also requires CAF Phase II recipients to obtain irrevocable letters of credit and bankruptcy opinion letters.⁷⁰

For all these reasons, the Commission should reject adding the "five-point" screen to its existing financial qualifications, at least for experienced applicants.⁷¹

⁶⁸ By contrast to the extensive financial inquiries for the Auction, for the Mobility Fund auctions, the Commission is only requiring an applicant to "certify that it is financially and technically qualified to provide the services supported." *Connect America Fund, Universal Service Reform—Mobility Fund*, WC Docket No. 10-90, WT Docket No. 10-208, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 2152, 2205, paras. 128-29 (2017).

⁶⁹ See Cramton at 11 (stating that "[d]ifferent bidders also bring different project skills and financial capabilities").

⁷⁰ 47 C.F.R. 54.315(c).

⁷¹ ACA is dismayed that the Commission is now proposing this additional screen after it worked with the Commission, in advance of the *Phase II Auction Order*, to develop the requirement that experienced providers that did not have audited financials would submit audited financials if they were winning bidders. That requirement addressed ACA's concern that these providers not be burdened by onerous financial qualifications and met the Commission's need to preserve the integrity of the auction by minimizing the risk of winning bidders not being able to perform. The

IV. ANTI-COLLUSION REQUIREMENTS SHOULD ENABLE PROVIDERS TO SHARE AUCTION EXPERTS WHILE PREVENTING PROHIBITED COMMUNICATIONS

ACA joined other commenters in supporting flexible anti-collusion requirements that allow providers to share auction experts, subject to safeguards to prevent prohibited communications of applicant bids or bidding strategies.⁷² The Commission “has emphasized that the [anti-collusion] rule is limited in scope and only prohibit[s] disclosure of information that affects, or has the potential to affect, bids and bidding strategies.”⁷³ The Commission has long recognized that an auction participant “may want or need to communicate bids or bidding strategies to third parties such as counsel, consultants or lenders.”⁷⁴ The anti-collusion requirements therefore do not prevent an auction applicant “from communicating bids or bidding strategies to a third-party consultant or consulting firm, provided that such an applicant takes appropriate steps to ensure that any third party it employs . . . does not become a conduit for prohibited communications.”⁷⁵ Nevertheless, the Commission asked in the Public Notice whether it should adopt new or more restrictive anti-collusion requirements to prevent prohibited communications in the Auction.⁷⁶

Commission is effectively nullifying that requirement by proposing to add the “five-point” scale and some unknown further review if the provider does not pass the screen.

⁷² 47 C.F.R. § 1.21002(b) (prohibiting auction applicants from communicating their bids or bidding strategies to competing applicants after the deadline for submitting applications to participate in the auction unless such applicants are members of a disclosed joint bidding arrangement).

⁷³ *Guidance Regarding the Prohibition of Certain Communications During the Incentive Auction, Auction 1000*, AU Docket No. 14-252, GN Docket No. 12-268, WT Docket No. 12-269, Public Notice, 30 FCC Rcd 10794, 10795, para. 3 (2015) (internal quotations omitted) (“*Incentive Auction Guidance*”).

⁷⁴ *Id.* at 10798, para. 13.

⁷⁵ *Public Notice*, 32 FCC Rcd at 6244, para. 21. See *Incentive Auction Guidance*, 30 FCC Rcd at 10798, para. 13 (stating anti-collusion rule does not prevent communications related to bids or bidding strategies to third parties, provided the applicant takes preventative measures against prohibited communications).

⁷⁶ *Public Notice*, 32 FCC Rcd at 6244, para. 21.

None of the commenters in this proceeding supported the imposition of new or enhanced anti-collusion requirements prohibiting the sharing of third-party auction experts.⁷⁷ First, ACA agrees with other commenters that, given the potential complexity of the Auction, it will be essential for providers to be able to access the expertise of third-party consultants.⁷⁸ The commenters explained that many small and rural providers interested in bidding for Phase II support have never participated in a Commission auction before and generally lack the expertise or resources to devote to bid preparation.⁷⁹ As a result, the Rural Coalition noted that “the very providers the Commission wants to participate in this Auction . . . lack familiarity with auction logistics (e.g., software, data files, etc.), as well as the unique characteristics of this Auction (e.g., descending-clock format, decrementing percentages, weighting factors).”⁸⁰ Even if the Commission simplifies the Auction design as ACA recommends, the retention of auction

⁷⁷ See, e.g., Rural Coalition Comments at 8-9 (recommending the Commission “permit small business participants to retain . . . the same consultants, experts, and counsel that are retained by other bidders”); Comments of the Rural Wireless Association, Inc., AU Docket No. 17-182, WC Docket No 10-90, at 5 (“The Commission should specifically permit small business participants to retain . . . the same counsel (and, through counsel, consultants and other experts) that are retained by other bidders.”) (“RWA Comments”); WISPA Comments at iii-iv (stating that bidders must have “sufficient flexibility” to engage auction experts used by other bidders). See also Cramton at 8 (“The [auction] designer also should recognize that, to encourage participation, it may need to permit some parties to share access to auction experts (albeit with requirements to inhibit collusion/coordination).”); *Lieberman Ex Parte* at 2 (“[T]he Commission should provide smaller entities with greater opportunities to use auction experts to help them participate in the auction.”); Letter from Rebekah P. Goodheart, Counsel to the Rural Coalition, to Marlene H. Dortch, Secretary, FCC, WC Docket No. 10-90, at 7-8 (July 26, 2017) (arguing the Commission should allow multiple providers to “rely[] on the same consultant or consultants during the auction process”).

⁷⁸ WISPA Comments at iii. See Rural Coalition Comments at i (“Because of the complexity of this Auction, and given their relatively small staffs, smaller providers will almost certainly be unable to participate without retaining third-party consultants, outside experts, and/or counsel.”); RWA Comments at 3 (“[T]he auction’s complexity, coupled with the Commission’s anti-collusion rules, may limit its members’ participation.”).

⁷⁹ Rural Coalition Comments at 6-7. See US Cellular Comments at 11 (stating that smaller providers “are at a natural disadvantage in any auction, given their relative lack of bidding expertise and resources to devote to bid preparation”); WISPA Comments at iii (highlighting the importance of access to third-party auction experts for “smaller [bidders] that have never participated in a Commission auction before”).

⁸⁰ Rural Coalition Comments at 12.

experts likely still will be necessary.⁸¹ Harsh anti-collusion requirements preventing bidders from sharing auction experts will deter provider participation in the Auction and lead to an “arms race” where “the most knowledgeable experts will likely be retained by the largest would-be bidders who can promise the greatest levels of activity and remuneration for those expert firms.”⁸² The Commission therefore should provide sufficient flexibility for bidders to share the costs of an expert, which will encourage greater participation by small and rural providers and allow such providers to compete against larger providers on a more level playing field.⁸³

Second, ACA agrees with other commenters that competitive harm caused by coordinated bidding is less likely in the Auction when compared to the broadcast incentive auction.⁸⁴ WISPA commented that Auction participants will bid for small, discrete areas that are unique to their business models and likely contiguous to or near their existing operations.⁸⁵ WISPA asserted that bidders would have minimal incentives to collude with competitors and stated that a bid for one census block in one part of the country would have “at most, an extremely remote effect” on a bid for another census block in another part of the country.⁸⁶ The Rural Coalition also pointed out that the benefit obtained by broadcasters in the incentive auction “effectively was cash, which is fungible and transferable,” increasing the likelihood that one auction participant would offer another participant some portion of the auction windfall if it dropped out of bidding.⁸⁷ By contrast, Auction participants will be competing for Phase II

⁸¹ *Id.* at 7.

⁸² *Id.* at 9. See WISPA Comments at 5 (noting the relative dearth of “qualified consultants capable of providing critical expertise on bids and bidding strategies”).

⁸³ *Lieberman Ex Parte* at 2.

⁸⁴ WISPA Comments at 5; Rural Coalition Comments at 10.

⁸⁵ WISPA Comments at 5.

⁸⁶ *Id.*

⁸⁷ Rural Coalition Comments at 10.

support tied to the bidder's provision of broadband services at certain performance/latency tiers to unserved high-cost areas, limiting the opportunities for "under the table" payoffs.

Finally, ACA agrees with other commenters that Auction participants planning to share third-party experts should develop firewalls and other compliance procedures to prevent such outside parties from becoming conduits for prohibited communications.⁸⁸ Specifically, ACA reiterates its recommendation that bidders can satisfy the anti-collusion requirements by establishing written procedures, which would be submitted to the Commission upon request, identifying specific types of prohibited communications and sharing these procedures with all individuals involved in bidding.⁸⁹ The establishment and adherence to such procedures would address concerns with multiple applicants employing the same individual or firm for bidding advice and limit the potential that an expert possessing information about the bidding strategies of one applicant could (potentially inadvertently) provide advice to another applicant influenced by such information.⁹⁰ ACA also supports WISPA's "safe harbor" proposal, under which a bidder would satisfy the anti-collusion rule if its consultant does not advise another applicant bidding for the same census block.⁹¹ While WISPA's proposal may lead to a shortage of

⁸⁸ See WISPA Comments at 6 ("[C]onsulting firms should establish appropriate internal safeguards and firewalls to ensure that they do not act as conduits for prohibited communications between or among bidders."); Rural Coalition Comments at 8 ("For third parties that may advise multiple licensees on bids or bidding strategies . . . firewalls and other compliance procedures should be implemented to help prevent such third parties from becoming conduits."); see also *Lieberman Ex Parte* at 2 (stating Commission should allow bidders to share auction experts "subject to firewalls and other protective measures").

⁸⁹ ACA Comments at 7-8. In recommending the submission of the written procedures to the Commission, ACA is not suggesting that the Commission must review and approve the procedures before a bidder is allowed to participate in the Auction. Instead, the written procedures provide a clear, efficient method for satisfying the Commission's requirement that bidders sharing third-party experts establish firewalls and other compliance procedures to prevent prohibited communications. See *Public Notice*, 32 FCC Rcd at 6244, para. 21; *Incentive Auction Guidance*, 30 FCC Rcd at 10798, para. 13.

⁹⁰ See *Public Notice*, 32 FCC Rcd at 6244, para. 21 (noting that the Wireless Telecommunications Bureau previously expressed concerns regarding the use of the same auction expert by multiple bidders); *Incentive Auction Guidance*, 30 FCC Rcd at 10800, para. 15 (highlighting the potential for inadvertent sharing of auction advice by an expert retained by multiple bidders).

⁹¹ WISPA Comments at 5.

available auction experts for particularly attractive census block groups, the proposal provides clear, easy to implement guidance to bidders when seeking and retaining experts to assist in the Auction. No matter what procedures it adopts, however, the Commission should ensure that its anti-collusion requirements allow bidders ready access to auction experts to foster participation and efficient outcomes for smaller providers in the Auction.⁹²

V. THE AUCTION, EVEN PRIOR TO THE *PUBLIC NOTICE*'S PROPOSALS ON AUCTION DESIGN AND QUALIFICATIONS, INHIBITED PARTICIPATION IN MANY WAYS; ACCORDINGLY, THE COMMISSION SHOULD ACCEPT ACA'S RECOMMENDATIONS ON THE *PUBLIC NOTICE*'S PROPOSALS, WHICH WILL HELP ENSURE PARTICIPATION

As indicated in the Introduction, the Auction is the “first-time” the Commission will use competitive bidding to award fixed line universal service support in unserved areas, and it is important to recognize that it is unlike spectrum auctions in a number of fundamental ways, all of which weigh against potential providers deciding to participate and which should affect how the Commission addresses concerns raised by ACA and others with the *Public Notice*. Some of these differences are due to the inherent nature of the lots, the different technologies that may be used to satisfy the public interest obligations, and the fact that some potential bidders are already present in the eligible area and others are not. Other differences are due to policy choices made by the Commission. Let us explain further –

- All eligible areas are served by incumbent price cap carriers, albeit with insufficient broadband service. This gives these carriers an advantage in building a business case and developing a bidding strategy. This is especially the case because these carriers just completed their due diligence for most of

⁹² ACA echoes the Rural Coalition's call for the Commission to conduct further industry outreach on both the Auction procedures and the application of the anti-collusion rules. Rural Coalition Comments at 11. Such outreach efforts are invaluable to small and rural providers participating in their first Commission auction. However, ACA also agrees with RWA that, “[w]hile fact sheets, user guides, and Commission outreach are helpful, prospective bidders must be able to rely on advice from their consultants, experts, and lawyers during competitive bidding periods.” RWA Comments at 3.

these areas — and certainly the most attractive areas — as part of the Phase II “right of first refusal” process. Other bidders, by contrast, are starting from scratch and will need to undertake due diligence and build their business case *de novo*, a non-trivial cost.

- The reserve prices for the Auction use the support amounts established by the Connect America Cost Model (“CAM”), which is based on the cost to deploy a fiber-to-the-home network over the long term. But bidders in the Auction can use a variety of network technologies that are significantly lower in cost than fiber-to-the-home. In addition, the Phase II program requires providers to deploy over the short term. Thus, there is a material mismatch between the CAM and the Phase II program. These same flaws were manifest for the Phase II “right of first refusal” or “cost-model” program, and, because of these issues, it is difficult to conclude that this model-based support was awarded efficiently or that consumers received optimal broadband service. Using the CAM to set reserve prices for the Auction will almost certainly lead to the same result. “Fiber” providers will sit out the bidding in areas where they believe non-fiber technologies have a cost advantage, enabling them to bid lower. These providers also will sit out the bidding in areas where they believe the business case supports higher performance networks, but support awarded at the reserve price will be insufficient.
- The Commission did not establish weights for the different performance/latency tiers based on the cost of deploying facilities using different technologies and providing services over those networks. But costs and revenues are at the heart of any business case a potential bidder will develop and will underlie any bid. Thus, the weights, as arbitrary factors, will inject tremendous uncertainty into

developing a business case and bidding strategy, effectively raising the cost to participate.

- Eligible areas (lots) in the Auction are likely to be less substitutable and less complementary than in spectrum auctions, which will limit where potential providers may bid. An incumbent carrier may bid in its own territory, but it is almost certain not to bid against another incumbent carrier. Nearby wireline providers — and maybe even fixed wireless providers — will find it most efficient to bid in abutting areas but not in more remote areas. Satellite providers may be alone in having a “national” view, but they will bid only for the lower performance/latency tiers. As a result, participation in the Auction is likely to be inherently lower.

In sum, the Commission is already challenged, prior to the dealing with the Auction design and procedures, in maximizing participation in the Auction. As a result, the Commission should “not keep on digging” and adopt an Auction design and procedures that are complex and would further discourage participation, especially by smaller providers. The Commission therefore

should revise its proposals to prohibit package bidding and tier shifting between rounds, adopt its proposal to limit “switching” of areas between rounds, reject the “five-point” financial screen, and enable bidders to share auction experts.

Respectfully submitted,

By: 

Matthew M. Polka
President and Chief Executive Officer
American Cable Association
Seven Parkway Center
Suite 755
Pittsburgh, PA 15220
(412) 922-8300

Thomas Cohen
J. Bradford Currier
Kelley Drye & Warren LLP
3050 K Street, NW
Washington, DC 20007
(202) 342-8518
Counsel to American Cable Association

Ross J. Lieberman
Senior Vice President of Government Affairs
American Cable Association
2415 39th Place, NW
Washington, DC 20007
(202) 494-5661

October 18, 2017

Attachment: Peter Cramton, “On the Design of the Connect America Fund Phase II Auction”
(Oct. 18, 2017)

ATTACHMENT



On the Design of the Connect American Fund Phase II Auction

Peter Cramton¹

University of Maryland and University of Cologne

18 October 2017

Abstract

The Federal Communications Commission (FCC) proposes to use a descending clock auction (Auction) to identify recipients of Connect America Fund (CAF) Phase II support and to use the “second-price” rules to determine the amount of support. The FCC already has decided that participants will bid by offering a percentage below the reserve price (rather than an absolute price) and will have bids adjusted by four performance tiers and two latency tiers. In the FCC’s Public Notice, it proposes several additional auction design features. These include package bidding, proxy bidding, the ability to shift performance/latency tiers between rounds, activity rules, and bid processing rules. Some of these features, however, add materially greater complexity to the Auction and will discourage many potential participants from bidding. As a result, the Auction will not produce efficient outcomes. Accordingly, the FCC should eliminate certain features, such as package bidding and tier shifting, that add dubious value and thwart the FCC’s aim to maximize participation.

¹ Professor of Economics, University of Maryland and University of Cologne, www.cramton.umd.edu. Since 1983, Peter Cramton has conducted research on market design; he has applied that research to design auction-based markets of radio spectrum, electricity, financial securities, and other products. I thank the American Cable Association for funding this research and Pacharasut Sujarittanonta for helpful comments.

Contents

Summary	3
Introduction	4
Desirable properties of auctions for CAF obligations	4
As simple as possible, but not too simple	6
Objectives	7
Efficiency	7
Simplicity	7
Transparency	8
Fairness	8
Discussion	8
Setting	9
Product design	10
Relevant characteristics of the CAF auction	10
Clock auctions	12
Clock auction without switching	12
Clock auction with limited switching	12
Clock auction with package bids	13
Assessment of the FCC's proposed features	13
Performance tier and latency	13
Intraround bidding	13
Minimum acceptable annual support amount	13
Activity rules	14
Package bidding	15
Recommendations	16
Glossary	17
References	21

Summary

This paper examines auction design for the CAF Auction, where the FCC proposes to use a descending clock auction with a host of additional features. The concern is that this Auction will be so complex that it will discourage competent and qualified entities from participating. In this paper, I assume that the FCC will use a descending clock auction, and then evaluate the various features to determine whether they thwart participation and efficient outcomes, and if so, how they should either be modified or eliminated. In sum, I recommend that the FCC can safely simplify certain elements of the proposed design and better achieve the FCC's objective of allocating the scarce CAF budget to maximize social welfare. A simplified activity rule can help avoid parking strategies that are apt to favor large bidders. These parking strategies undermine outcome discovery and frustrate auction participation.² The simplified activity rule, which only allows switching among service areas during the opening rounds of the auction to address potential miscoordination, is both simpler and more powerful than the FCC's proposal.

Although I understand the FCC's proposal handles a potentially broader set of economic scenarios—for example where complementarities are stronger and more varied across participants and where substitution across areas and qualities are more important—the FCC's proposal adds needless complexity that the most sophisticated bidders can and would take advantage of. The likely result of the FCC's proposal is an auction with less participation, less competition, and a greater likelihood of undesirable foreclosure in the market for broadband services. To better serve the objective of maximizing social welfare, the FCC should simplify the auction, thereby encouraging participation and competition. The simplified auction also reduces risk of implementation. The broadcast incentive auction demonstrated the FCC's capabilities of conducting amazingly complex auctions when enough time and money is available for testing and implementation. This however does not imply that auction complexity is a good thing. It is not. The FCC should make the CAF auction as simple as possible to address the economic problem at hand.

Here is a list of desirable simplifications.

Geographic areas. Adopt the Public Notice's proposal to use a census block group as the minimum geographic area for bidding. A census block group is small enough to accommodate the smallest qualified bidders, yet avoids extra complexity from blocks that are so small that, when combined with package bidding, would enable gaming strategies analogous to gerrymandering.

Round structure and activity rule. Divide the auction into two stages, an opening stage with the standard eligibility-point activity rule that permits switching of geographic areas—but not quality—and a closing stage in which there is no switching supply across geographic areas. This stronger activity rule in the closing stage eliminates parking strategies that would otherwise compromise outcome discovery and reduce the efficiency of the auction. Such a powerful activity is warranted in the CAF setting because of the underlying economics of broadband service provision. Substitution across service areas and technologies is limited by each bidder's existing infrastructure and technological expertise. Allowing substitution of areas and qualities beyond a bidder's underlying economics is simply an invitation to gaming—gaming that favors the largest and most sophisticated bidders at the expense of the smaller bidders, who are essential for a competitive auction.

Package bidding. Package bidding is a desirable complicating feature in auction settings where complementarities are strong. That is not the case in the CAF setting. To a first approximation, bidders in the CAF auction have additive costs. Thus, a much simpler auction without package bidding is possible. A key advantage of an auction without package bidding is that it avoids gaming strategies that favor the largest and most sophisticated bidders. Without package bidding, large bidders exercise market power by making room for smaller rivals (Ausubel et al. 2014). The result is encouraged participation, more

² See the glossary for the definition of outcome discovery and other technical terms.

competition, and less concentration in broadband services. With package bidding, the CAF auction will have fewer bidders, fewer winners, and less creation of social welfare. Although I am an avid supporter of package bidding in auctions where complementarities are strong and varied among bidders (*e.g.*, Cramton et al. 2006), I appreciate the damage package bidding can do in settings where it is not warranted.

Proxy bidding. I fully support the FCC's use of proxy bidding. This allows small bidders with simple economics to participate in the auction at lower cost. For example, a bidder with existing infrastructure in a single census block group can submit its cost of service in the first round of the auction. There is no need for the single-minded bidder to set up a war room and participate in the auction on a round-by-round basis for many days or weeks. Outcome discovery is no value to such a bidder. Importantly, the FCC should not cripple the power of proxy bidding by limiting the bidder's expression of costs, as it did in the broadcast incentive auction.

Shifting performance/latency tier. One could imagine that allowing a bidder to shift performance/latency tiers during the dynamic auction might be desirable. It is not. In the CAF setting, it is unlikely that an individual bidder would have a meaningful trade-off among performance/latency tiers. Allowing this trade-off in the CAF auction opens the door for gaming strategies that a large sophisticated bidder can take advantage of to foreclose competition.

Introduction

With the CAF Auction, the FCC seeks an auction design that will make the best use of the limited funds that are available for bringing broadband services to certain unserved (non-economic) areas. This is a difficult economic problem. Fortunately, the FCC can draw on the experience of the past two decades—particularly the experience worldwide in allocating scarce communication spectrum—which has yielded strong support for the notion of allocating scarce public assets by auction. Moreover, it has become abundantly clear that different auction formats have various advantages and disadvantages for accomplishing the objectives of policymakers, and that considerable effort is justified in getting the auction design right.

This paper assumes the FCC will use a descending clock auction with amounts awarded using a second-price rule. Here I provide guidance on what features for the CAF auction best achieve efficient outcomes. More specifically, this paper focuses on developing and describing best practices within the class of price-only auctions. I accept that the FCC has already decided on a scoring rule that translates multiple factors (price and quality of service) into a single dimension, which is the bidding variable. I refer to the bidding variable as price, which is stated as a percentage of the reserve price for the specified quality in the service area. The auctions studied determine, in an open competitive process, the assignment and pricing of obligations to provide broadband service.

My objective is to provide expert guidance on how best to conduct the Phase II auction. Getting the auction design right is especially important given the high level of inertia in almost all government programs. The design that is used here could realistically be anticipated to be the design that is used in future years. Good auction design and implementation will be essential to the efficient allocation of the fund.

For purposes of this paper, the unit being auctioned is a “lot,” which also is the “service area.” A winning bidder will receive payment for fulfilling its obligation to provide broadband service of the specified quality or better in the service area, as well as voice service.

Desirable properties of auctions for CAF obligations

There are three main principles of effective auction design in the CAF setting.

Enhance substitution. First in terms of the auction design, it is important to enhance the possibilities for substitution across the lots being bought. This enables the bidders to adapt their service area configurations by substituting among lots during the auction to minimize cost. Enhanced substitution is accomplished through both the product design—what is auctioned—and the auction format. In the CAF setting, the product design can be almost as important as the auction format. Relevant tools include varying the size of lots and expanding lot sizes to larger sizes in situations where most bidders would likely view any component sub-blocks as complementary. Finally, the auction format can impact greatly the ease of substitution among lots.

The CAF auction differs from spectrum auctions in that for most bidders each lot may not be fungible with other lots around the country, particularly for smaller wireline providers. In general, wireline providers, to achieve economies of scale, will bid near where they have existing facilities. AT&T may have a greater presence than a small cable operator, but it is most likely to bid where it already provides service—although this greater presence will enable it to have greater substitutability. AT&T also could bid as a fixed wireless provider where it has mobile service, but that is a lesser possibility. The small cable operator, which is unlikely to have any facilities in any eligible area, will bid in abutting areas. That probably holds for a fixed wireless provider, although because their network deployment costs are somewhat lower, they may wander into newer areas. Of course, satellite providers can examine the market nationally. In sum, for non-incumbent wireline providers, substitution of lots may be limited. Thus, the FCC should be careful in striving to enhance substitution to not assume that all lots are potentially substitutable or complementary. Rather, an additive cost function is apt to approximate well the underlying economics of service provision.

Encourage outcome discovery. Second, encouraging outcome discovery—both price and assignment—is important. This requires a dynamic auction process. Although a provider's cost of service is well-understood, it depends on the lots won and therefore learning about likely winnings is important for cost estimation and efficiency. The bidders need to do pre-bid analysis to develop a cost model, and their decision-making will benefit further from the collective market insights, which can be aggregated and revealed via a dynamic auction process.

One especially helpful aspect of a dynamic auction is that, through this auction process, the bidders gradually improve the sense of where prices will end up and what lots are most relevant to them. Focusing bidder decisions on what is relevant is a major source of benefit from the dynamic process. In the CAF auction, bidders are apt to have a well-specified cost model, but costs will depend on assignments.

A dynamic process, by reducing common cost uncertainty, also reduces the winner's curse, the tendency for bidders to overbid and get underpaid in competitive auctions. However, the FCC needs to understand that the CAF auction may not raise this concern. The FCC just gave price-cap carriers support using the Connect America Fund model. In some cases, however, this amount may have been excessive. The carriers surely undertook detailed analysis by each census block of whether to take support—although they had to choose either all blocks in a state or none. In addition, an abutting provider will have a relatively good idea of the cost to build to an eligible block, although not as good as the incumbent price-cap carrier, which already serves the block.

Induce truthful bidding. A third principle worth emphasizing is the importance of inducing truthful bidding. Ideally, bids are based on providers' intrinsic costs of providing service. This is accomplished in the auction design through an effective pricing rule and an activity rule. If these are designed well, such that there is little benefit for a bidder to bid untruthfully, the two rules work together to encourage bidders to truthfully express preferences throughout the entire auction. This truthful expression of preferences is what leads to improved outcomes from better outcome discovery during the bidding process.

A variety of different pricing rules are used in auctions in practice. The two most common rules are “first price” or paid-as-bid pricing, where winners are paid the amounts they bid, and “second price,” where winners are paid an amount that is just sufficient to better the losing bids.

Beginning with the broadcast incentive auction, the FCC has wisely moved to state-of-the-art clock auctions. The FCC plans to do the same in the CAF auction. While I fully support this decision, it is important to recognize that state-of-the-art clock auctions have many features that need to be customized for the setting. This includes the pricing rule, the activity rule, and the information policy. I examine each of the critical features in the context of the CAF auction.

In this setting, the activity rule is key. The simplest design is a *clock auction without switching*—no switching across areas or qualities is allowed. Such a design performs well when bidders’ cost functions are approximately additive—the cost of serving A+B is the cost of serving A + the cost of serving B. A more complex design, the *clock auction with package bids*, permits greater substitution across areas and qualities with an aggregate activity rule, such as the use of eligibility points and requiring a bidder maintain a certain level of activity in eligibility points to maintain the same level of eligibility in subsequent rounds. This activity rule has been used in nearly all FCC spectrum auctions. A key advantage of a clock auction is that the auction can allow package bidding in a most simple way—without the need for complex combinatorial optimization. However, treating bids as package bids still opens the door for certain forms of gaming behavior and fundamentally transforms how market power is exercised. A further drawback of package bidding is the possibility of unspent budget because of a large drop in supply by one or more bidders in the final bidding round. A third version of clock auctions is the *combinatorial clock auction*, which attempts to address this problem of large drops in supply with a supplementary round following the final clock round. The supplementary round also permits bidders to express a richer set of preferences. However, this comes at the cost of greater complexity and to some extent undermines outcome discovery in the clock stage. The FCC has wisely decided against the combinatorial clock auction in the CAF auction. I therefore focus solely on the clock auction without switching, the clock auction with limited switching, and the clock auction with package bids.

All clock auctions are multiple round auctions in which, in each round, the auctioneer announces prices and the bidders respond with offers to serve at the specified prices. Prices then decrease on products with excess supply and the process repeats. The auction ends when there is no excess supply for any product.

As simple as possible, but not too simple

Albert Einstein’s advice that we should “make things as simple as possible, but not simpler” is an important principle of market design. While many subscribe to Occam’s razor, which advocates the simplest solution, Einstein’s razor is an important refinement.

In early spectrum auctions, there was a tendency for regulators to adopt auction approaches that were overly simple for the setting. Worse yet, the regulator mistakenly evaluated simplicity with respect to the complexity of the auction rules, rather than the complexity of participating in the auction and formulating sensible bids. Simple auctions can work well in simple environments, but more complex auction formats are needed in more complex settings. A good example of this is a sealed-bid first-price auction. While such an auction is easy to conduct and explain, it is extremely difficult for bidders to bid in, as the bidder is bidding “in the dark” and needs to guess what bids are going to be placed by competitors to determine what bid to place to win a lot.

Today, with the advancement of our ability to implement complex auctions—the FCC’s broadcast incentive auction is a lead example—there is the potential for regulators to adopt auction designs that are more complex than they need to be. One reason for this is that the regulator often lacks sufficient

information of the setting and the more complex designs offer the potential of resolving more complex economic problems that may not exist.

In my overall recommendations, I adopt Einstein's razor. The FCC faces a variety of auction scenarios. Some are simple, such as the auctioning of a many nearly identical lots—a single-band spectrum auction; others are complex, such as the auctioning of multiple interrelated and dissimilar lots, with strong and varied complementarities among lots.

The remainder of the paper is organized as follows. I begin with a discussion of the basic ingredients of market design. Then I discuss the basic auction formats most relevant for auctioning Connect America Fund support: the clock auction without switching, the clock auction with package bids, and a clock auction with limited switching. I then conclude with my recommendations.

Objectives

Auction design begins with the objectives. Then the designer tailors the design to best serve these goals given the economic setting. In broadest terms, the FCC seeks to make the best use of limited Connect America Fund support. This involves bringing efficiently broadband services, whose quality the FCC has established, to unserved areas and close the “digital divide.”

Many factors complicate the economic problem of achieving best use from limited funds. Three are especially important in the context of broadband services and the CAF Auction: 1) the quality of the service is variable, 2) the cost of providing service may depend on many variables, including whether the bidder already serves the areas or is providing broadband services in neighboring areas or the technology used to deliver the service, and 3) the auction may impact the market structure for broadband services in significant ways. The designer must consider how the auction design effects competition and innovation for broadband services, both locally and nationally.

Efficiency

Economic efficiency—using the limited funds to maximize social welfare—is the core objective. This core goal is complemented with three other auction objectives: simplicity, transparency, and fairness—all of which will bear on whether the efficiency aim is achieved.

Simplicity

The auction should be as simple as possible, but not simpler. In the case of the CAF Auction—a reverse auction—the economic problem to be solved is complex, and thus some complexity in the design is necessary. Still, designers should strive to keep the design as simple as possible. Complicating features should only be added if they are necessary and consistent with the core principles.

Simplicity is best measured in terms of the simplicity of participating in the auction. Clear rules that make it straightforward to develop an effective bidding strategy get high marks for simplicity. Simpler auction designs tend to avoid guesswork. For example, a straightforward descending clock design that facilitates outcome discovery, both with respect to clearing prices and the prospects for winning, is a simpler design than a static auction in which bidders, especially those with many options (*e.g.*, bidding areas and technologies), must engage in substantial guesswork and speculation to determine an effective bidding strategy. In the CAF auction, an incumbent provider likely has good information about the cost to serve, especially since it just went through a cost-estimation process in deciding whether to take funding pursuant to the right-of-first-refusal process. An abutting competitor will have a more difficult time in estimating costs.

Simpler designs also limit risks to bidders. Again, dynamic designs with good outcome discovery often let the bidder better manage budget and portfolio constraints. Executing a business plan is often more straightforward in such designs.

Simpler designs tend to promote efficiency by letting the bidder express preferences more simply and effectively.

Transparency

A first requirement of transparency is clear and unambiguous rules that map bids into outcomes. With a transparent design, bidders know why they won or lost and understand why their payments are what they are. Bidders are able—at least after the event—to confirm that the auction rules were followed.

Higher levels of transparency are achieved in auction designs that have excellent outcome discovery—both with respect to prices and prospects for winning. These are dynamic auctions, such as the descending clock auction, in which substantial information is provided to bidders to understand prices and winning prospects during the auction. Still the auction designer should recognize that the release of some information could potentially be used to foster collusion or improper coordination among bidders. The designer also should recognize that, to encourage participation, it may need to permit some parties to share access to auction experts (albeit with requirements to inhibit collusion/coordination). Transparent reverse auctions have an information policy that reveals information that is most helpful in understanding supply. Such designs promote outcome discovery, which generally promotes auction participation and competition.

Fairness

Equal opportunity is a basic requirement of fairness. All potential participants should have access to the rules and the rules should not inappropriately discriminate among parties. The design should refrain from favoring or disfavoring any party based on that party's size or market status. The FCC has sought to attain this objective by establishing public interest and deployment obligations applicable to all bidders and by establishing a methodology to weight bids based on technology. Prior to permitting a party to bid using a technology, the FCC should ensure that it can meet the obligations it has established to preserve the fairness and integrity of the auction.

Another consideration is whether to use certain instruments to favor one or more classes of bidders. This may seem at odds with the fairness norm. However, such instruments are used to level the playing field in response to disadvantages the favored group would otherwise face. For example, in the US spectrum auctions, the FCC used bidding credits, set asides, and installment payments to favor small businesses and rural operators. I have studied the impact of such policies in my research. Some approaches have been successful, while others have not. My conclusion is that care is needed to employ these instruments successfully.

Discussion

Now that the four objectives have been defined, it is helpful to view them in combination. To a large extent, the objectives are complementary. The auction designer can choose a design that gets high marks with respect to each objective. This is most easily seen when we abstract from details and consider the auction of a single divisible good.

Consider a single-price descending clock auction in a competitive setting in which aggregate supply is reported after each round. I claim that this auction gets high marks with respect to all four objectives. First, the auction is a simple price discovery process. Bidding strategy amounts to estimating the cost of providing service and then exiting when this cost is reached. Second, the auction is highly transparent.

The rules are clear and it is easy to see why a bidder won or lost at a price. The revelation of aggregate supply promotes excellent outcome discovery, both about the market price and the prospects for winning. Third, the auction is fair. Every potential bidder faces the same rules and all trade takes place at the market-determined clearing price. And finally, the auction is efficient. Given the straightforward and effective bidding strategy of exiting when cost is reached, the auction is fully efficient, maximizing total surplus.

Of course, when we move from a straightforward descending clock auction and introduce complicating details, the design becomes much more complex and may reduce the ability to achieve the objectives. That is what has happened with the FCC's proposed CAF Auction, where the FCC must recognize variable quality of the service, complementarities in serving neighboring areas, and competition issues in the downstream market for broadband services.³ However, as we will see, these issues can be addressed with a far simpler auction design so that it is still possible for the auction design to perform well with respect to the four complementary objectives, as we will see.

Setting

Winning CAF bidders must provide broadband service of specified quality from one or more technologies, as well as voice service. For the most part, these technologies are well-understood. One uncertainty is the rate of innovation and price declines. Cost declines will vary for each technology. Incumbents, which are likely to deploy DSL, once thought they had to deploy more fiber, which is expensive, but have met the FCC's performance requirements by installing new and far less expensive electronics. On the other hand, an abutting wireline provider, if it wins the bid, will need to undertake a large construction project to deploy new wires. That cost cannot be reduced. As for satellite providers, they have an enormous up-front cost, and so, if the satellite is already in the sky, their costs of entry are small.

The CAF auction involves the auctioning of many related but heterogeneous lots. The lots will be viewed as both substitutes and complements, and the structure of these preferences may be complex, especially across bidders. Depending on a bidder's technology, substitution may be limited, for example a small operator with complementary infrastructure in certain areas. However, complementarities appear not to be strong, provided lots are not too small. As a first-order approximation, an additive valuation model (cost function) would seem plausible for most bidders.

Assuring competition in the auction and in the market for broadband services is especially important in this setting. An absence of competition would have three undesirable effects: 1) poor use of scarce CAF money, 2) windfall profits, and 3) less pressure for quality broadband service.

Competition in the auction is assured by encouraging participation—making the auction as attractive as possible to potential bidders, especially small bidders. Auction designs that favor large bidders will not achieve the FCC's aims as these bidders will prevail at inefficient prices. This will not only waste CAF resources and potentially deprive consumers of sufficient broadband service, but it will provide these bidders with additional funding to compete in served markets.

³ One may think that competition in downstream markets is not relevant for unserved areas. This is not the case. Each service area has adjacent areas. The market structure in these adjacent areas impacts the potential competition for subsidies in a non-economic area, especially when technological advances may make the area viable for competition. A structure in which all adjacent areas are served by the same monopoly provider is less competitive than one in which the adjacent areas are served by different and multiple providers.

Product design

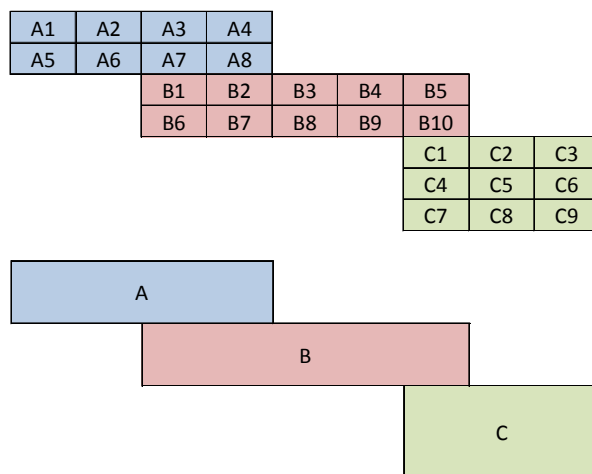
Product design—determining how the CAF obligations are defined and what factors are bid—is an important element of the auction. Again, I take as given the scoring rule that transforms the bidding into a competition over a single dimension, which I call price. The key issue that remains in debate is the geographic size of the lots.

For simplicity, the lots should be made as large as possible without excluding any important class of potential bidders. The technologies that potential CAF participants may use have much different cost structures and scale efficiencies. For instance, incumbent wireline providers using DSL technology may need to deploy fiber closer to locations, which is relatively costly, but they are increasingly foregoing this expensive option and using amplification, bonding, and vectoring to upgrade performance, all of which can be deployed at much less cost and incrementally. In contrast, a new wireline entrant will need to undertake a very expensive fiber build from scratch, although this too could be done incrementally as an extension from existing facilities should they be in place. As for satellite providers, if they already have a satellite in place, the additional costs to serve are not that significant and with spot beams they can target limited areas.

In my discussions with small cable operators, who are likely to extend plant into eligible areas, most have argued that census block groups would form a natural lot size. A census block group is small enough to enable participation from small operators and new entrants and yet large enough to construct facilities efficiently and thus to avoid the need for package bidding, at least if an auction design is used that has excellent outcome discovery.

As stated above, one simplifying step that should be performed during the product design is the pre-bundling of lots for which the bidders agree that the blocks belong together. An example is shown in Figure 1. Suppose the bidders agree that the blocks are logically grouped into three lots. Then the original blocks can be bundled to yield three lots, {A, B, C}, which can be auctioned, for example, using a clock auction with just three prices. The FCC achieves this objective by composing a lot from a combination of eligible census blocks into a census block group.

Figure 1. Bundled complementary blocks



Relevant characteristics of the CAF auction

It is worth comparing the CAF auction to that of the spectrum auctions. The auction settings are quite similar and therefore much can be learned from the spectrum auctions both in the US and elsewhere.

The CAF auction setting is reasonably like that of auctions for radio spectrum that have been conducted by the FCC beginning in 1994. Like spectrum, CAF obligations will be auctioned on a geographic basis; that is, the total area to be auctioned is subdivided into many smaller units that will be auctioned off. The bidders will bid for these units, and aggregate them as they see fit to build a package that suits their business needs.

A challenge for any auction is to determine how to define the units being auctioned in a way that enables the auction to produce an efficient outcome. For the CAF auction, this unit is defined to be a lot. Similarly, in spectrum auctions, the many spectrum blocks are each uniquely distinguished by geography, frequency, propagation characteristics, technology constraints, and adjacent spectrum users/users that could affect signal quality and cause harmful interference.

The lots themselves may be a complex blend of substitutes and complements—lots are substitutes when decreasing the price of one does not reduce supply for the other; complements are lots such that the cost of the lots combined is smaller than the sum of individual costs. Bidders typically require areas consisting of many complementary, adjacent lots. However, some bidders also have flexibility to substitute lots from one area to another. Thus, lots are both substitutes and complements and the structure of preferences may depend on prices. This is nearly identical to the case in spectrum auctions, where adjacent geographic areas are often complementary.

There are potentially many competing projects of various sizes in a CAF auction; the same is true for spectrum auctions. In a spectrum auction, one bidder may be interested in obtaining national spectrum to provide communications services on a nationwide basis while another bidder may be interested in obtaining spectrum in the Northeast for a regional business. In a CAF auction, one bidder may be willing to provide a service over one large area; whereas, other bidders may only want to provide service in a portion of this space. Each bidder likely has its own view on the optimum projects and these projects likely depend on the bidder's existing infrastructure and technologies. Different bidders also bring different project skills and financial capabilities, which would impact project configuration, valuation, and timing.

The market for CAF obligations is a long-term market. Winning bidders must make substantial, specific investments in building and operating the broadband service. As a result, the obligations extend many years. In spectrum auctions, winners must make substantial investments in the form of radio towers, transmitters and supporting network equipment to make use of the spectrum. Typical license terms in a spectrum auction range from between 10 and 20 years and in the US, licenses are generally renewed in perpetuity. CAF bidders are expected to make similar investments and have obligations extending over many years.

The FCC's primary objective in implementing the spectrum auctions is efficiency. The primary goal of the CAF auction is the same: to make the best use of the scarce Connect America Fund support. Like spectrum auctions—but unlike many other government auctions, such as Treasury auctions, where the goal is to auction the debt at least cost—here the goal is to spend the CAF to maximize total welfare.

Thus, the most relevant characteristics of the CAF auction are nearly identical to those of government spectrum auctions. For this reason, this enables me to draw heavily from the worldwide experience with spectrum auctions over the last 23 years. Indeed, spectrum auction design has been an extremely active area of research, with respect to both theory and practice. We have learned much and it will be important for the FCC to take advantage of the key insights from the existing research on and experience with spectrum auctions.

We agree with the FCC that it should use a descending clock auction—which is the analog of an ascending clock auction for spectrum. The clock auction without switching, the clock auction with package bids and the combinatorial clock auction are variants that address problems observed in spectrum

auctions. I discuss in greater detail the clock auction without switching and the clock auction with package bids, as well as a hybrid with limited switching next.⁴

Clock auctions

In this section, I discuss and compare three variants of the clock auction: the clock auction without switching, the clock auction with limited switching, and the clock auction with package bids.

In the clock auction, all lots are auctioned simultaneously. In each round, the auctioneer announces the current price of each lot. Bidders respond by bidding “in” or “out” on each lot. Bidders must keep active to maintain their eligibility. Prices decrease on lots where there is excess supply. In each round bidders see prices for each lot and then select their desired lots given the prices. Prices then decrease where we have excess supply. Bidders are free to adjust lots, subject to an activity rule, as prices decrease.

Clock auction without switching

The clock auction without switching has a stringent activity rule: no switching among lots. In this auction, once supply falls to one, the price of the lot no longer changes and the winning bidder is no longer able to exit from the lot. If there are complementary lots that continue to have excess supply—and so the price falls—the bidder may be forced to bid below his cost to win these complementary lots. Otherwise, the bidder could be left with the single lot which the bidder did not want on its own.

Therefore, the clock auction without switching works well when bidders have an additive cost function—the cost is equal to the sum of the costs of the individual lots bid upon. This may be a good approximation of the CAF setting, where we expect complementarities to be small. Moreover, it does best in avoiding gaming such as parking and supply reduction. Limiting strategic bidding with a strong activity rule reveals likely outcomes earlier in the auction and thereby improves outcome discovery. Lastly, there is little risk of under-spent budget, since bidders are unable to make drops in supply that would reduce spend.

Clock auction with limited switching

The clock auction without switching has one potential problem. Bidders with a limited aggregate capacity may have to decide without the benefit of outcome discovery on a limited set of lots—so as not to risk taking on too many obligations. Thus, there is a potential coordination problem if too many limited bidders initially select the same lots and leave other desirable lots unbid. The clock auction with limited switching addresses this potential problem with a two-stage process. In the opening rounds, the bidders can switch among lots, limited only by an aggregate activity rule. Then in the closing rounds, the activity rule is tightened to eliminate switching and thereby parking. Typically, the opening rounds are few, somewhere between two and six. This avoids the problem of unbid desirable lots, yet maintains the same powerful activity rule as the clock auction without switching—undesirable parking is eliminated.

This auction format is close to the one proposed by FCC. That is, a bidder can switch across lots from round to round, before the clearing round. However, the amount of switching defined by the bidder’s total implied support from bids in the previous round cannot exceed a switching percentage of 10 percent. In the clearing round and on, a bidder can no longer switch. This activity rule allows switching early in the auction during which the aggregate cost does not exceed the budget. As with the clock auction without switching, there is little risk of under-spend. The main difference with the limited switching approach here

⁴ I will not discuss the combinatorial clock auction in which all bids are package bids, since the FCC is not proposing this design. In addition, although the combinatorial clock auction performs well in some difficult circumstances, it also is the most complicated to implement and has certain undesirable competitive effects.

is that the switching is only allowed in the first few rounds. Most bidding rounds are closing rounds in which switching is prohibited.

Clock auction with package bids

In the clock auction with package bids, switching is allowed throughout the auction, subject to an aggregate activity rule. Importantly, bids are package bids. A bidder can make large drops in supply and these exits will be honored even if it means that a lot goes without a winner.

This clock auction variant is vulnerable to parking strategies, especially in lots with larger implied annual support, and it may lead to under-spend due to large drops by some bidders near the end of the auction. However, the flexible activity rule enhances substitution in some settings.

Assessment of the FCC's proposed features

Performance tier and latency

The FCC allows a bidder to change the performance tier and latency combination from round to round before the clearing round. This flexibility, however, gives bidders an effective instrument for gaming. For example, bidders may park using a low-weight performance tier and latency combination or misrepresent the combination to gain advantage over competing bidders. This in turn harms both outcome and price discoveries. Since in nearly all cases, a bidder will have a business plan with a specific performance tier and latency combination, there is little gained but complexity and gaming from allowing flexibility throughout the auction. The FCC should eliminate this flexibility, requiring bidders to specify a performance tier and latency combination in the initial round and then stick with it.

Intraround bidding

I strongly support the use of intraround bidding. The FCC proposes that a bidder may submit an exit bid at any price point percentage between the current and previous base clock percentage. In practice, clock auctions are conducted using discrete rounds and significant bid decrements, typically between 5% and 15% depending on the level of excess supply. Discrete rounds are used because bids must be binding commitments and even brief Internet access issues would create serious problems if a continuous price clock were used. In addition, discrete rounds give the bidders time to reflect and enable the auctioneer to better mitigate tacit collusion, both of which improve price discovery. See Ausubel and Cramton (2004) for a richer discussion.

Intraround bidding is both simple and powerful. It reduces the possibility of ties, since the price of exit is stated by the bidder. Moreover, the efficiency loss associated with the discrete decrements is eliminated. Each bidder's supply curve is continuous, just as with a continuous clock. As a result, the auctioneer can choose a larger bid decrement to speed up the auction process. This can both reduce transaction costs and mitigate the risk of tacit collusion.

Minimum acceptable annual support amount

The FCC proposes that the minimum acceptable annual support amount is equal to one percent of a lot's reserve price. I assume that when more than one bidder submits a bid of one percent, the tie is broken by some pre-determined rule. It is, however, possible that more than one bidder may wish to bid for the lot below one percent of the reserve price but the minimum prevents them to express their preference.

I proposed that the minimum acceptable annual support amount be zero. I do not understand the advantage of a higher minimum. The bidder gets to bid an exit price that prevents the bidder from winning at an unacceptable price.

Activity rules

With many lots, the auction requires many price clocks, one for each lot. This also requires a more sophisticated activity rule to determine the constraints on switching across the lots. This choice involves a difficult tradeoff: allowing greater flexibility in switching encourages substitution but also enables parking strategies that undermine outcome discovery; whereas, allowing little flexibility in switching encourages outcome discovery by preventing parking, but limits substitution across lots. The resolution of this tradeoff requires both judgment and good knowledge of the application.

I consider three alternative activity rules that attempt to resolve this trade-off. The simplest implementation of a clock auction is one that forbids switching among lots. Under the no-switching rule, the bidder must bid initially for the lot, and keep bidding for the lot until the bidder's cost is reached or the price stops declining because all other bidders stopped bidding for the lot. The second activity rule considered is one in which switching is permitted throughout the auction according to an aggregate activity rule. The aggregate rule can be implemented with package bidding. The final rule considered is a limited switching rule that allows switching in the opening rounds, but then eliminates switching in the closing rounds. This rule attempts to have some of the benefits the aggregate rule, but avoids the disadvantages.

No-switching rule. Bidders cannot switch among lots. If a bidder drops out from a lot, then he cannot bid on that lot in the subsequent rounds. A clock auction with this activity rule is sometimes called a clock auction without switching. Each lot closes independently. The no-switching rule works perfectly if bidders' cost functions are approximately additive. Parking is eliminated.

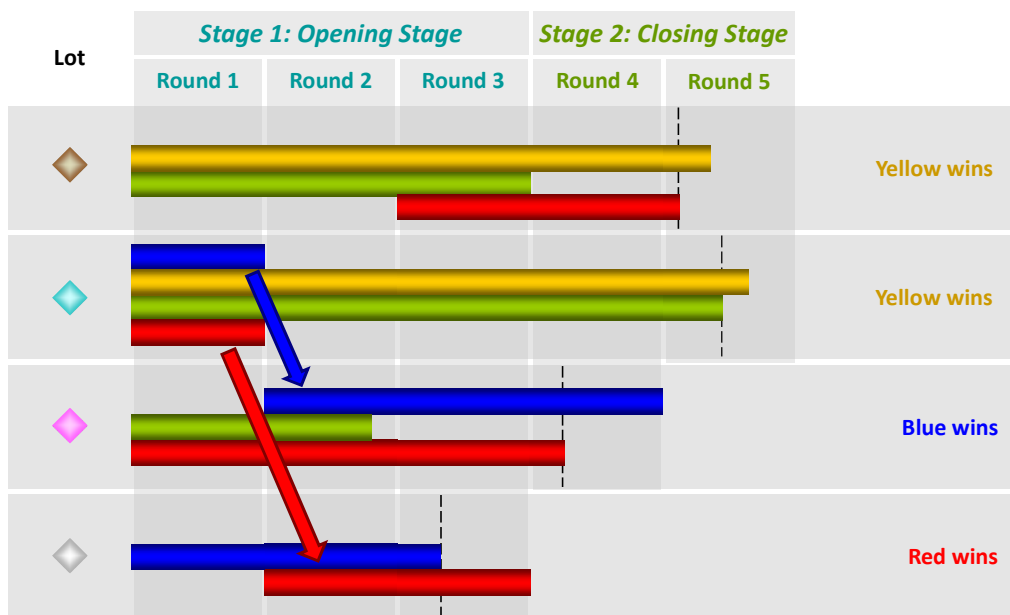
Aggregate rule. Bidders can switch freely among lots, subject to the constraint that the bidder's aggregate bid activity is weakly decreasing over time. Thus, in aggregate a bidder can maintain its overall level of activity or reduce its level of activity, but cannot increase its level of activity.

To measure activity, it is necessary to assign each lot some number of eligibility points that reflects the estimated relative value of the lot. The eligibility points for specific lots may differ. With this activity rule, bidders may switch freely among lots subject to the constraint that their total activity never increases as prices decrease. Thus, a bidder may at any time switch from 2 "large" lots with 3 points each to 3 "smaller" lots with 2 points each. In both cases, the activity is $2 \times 3 = 6$ points.

This aggregate rule allows greater substitution among lots. However, the rule enables parking strategies, which may distort bidding and discourage outcome discovery, especially if it is difficult for the regulator to estimate relative costs across lots. The aggregate rule has been used in nearly all spectrum auctions.

Limited-switching rule. There are two stages to the auction: an opening stage and a closing stage. In the opening stage, bidders can switch freely from one lot to another. In the closing stage, bidders can only bid on lots that they bid on in the previous round. The auction can be considered as a clock auction with switching for the opening stage—the first several rounds—and a clock auction without switching for the closing stage—the remaining rounds. Figure 2 shows a descending clock auction with limited switching. Blue and Red switch their bids during the opening stage in which bidders can freely switch across lots.

Figure 2. A clock auction with limited switching



The opening stage addresses the coordination problem that the bidders would face with a no-switching rule. Because of budget constraints or limited capacities, bidders may be unwilling to bid on all the lots even though the initial prices are low. They must therefore decide which among the many lots to bid on initially. If too few bidders select some lots in the initial round, the opening stage enables bidders to shift or expand their supply on the lots that received too few bids in the initial round.

Then in the closing stage, bidders cannot switch across lots, but only exit if the price gets too high. This allows some substitution, as bidders will tend to exit those lots that are a poorer value, but the substitution is not perfect. On the plus side, no switching in the closing stage eliminates parking strategies.

This limited switching activity rule is used without package bids. Once a winner is identified for a lot—there is no excess supply—then the winner is locked in and cannot subsequently withdraw. This activity rule works best when bidder values are largely additive: the value of the package is the sum of the individual values. This rule has worked well in diamond auctions since 2008. It is a good candidate for the CAF auction, since most bidders' costs are approximately additive.

The opening rounds are few, typically 2-6, and pre-specified. During the opening rounds, each bidder's activity is defined as the total implied support amounts for all the areas bid for in the current round. The aggregate rule requires that the activity in a round must not exceed the activity from the previous round. The aggregate rule is further strengthened by limiting a bidder's activity in a round by a switching percentage of 10 percent. The switching percentage limits a bidder's switching and thereby limits parking. I support this strengthening of the activity rule during the opening rounds.

The closing rounds start after the last opening round and continue for the remainder of the auction. During the closing rounds, no switching is allowed. A bidder can only win lots bid for in the last opening round. During the closing rounds, the bidder's strategy is to determine the lowest cost the bidder could accept and exit at that price. This activity rule simplifies bidding, limits gaming, and encourages outcome discovery.

Package bidding

The FCC proposes that a bidder may bid on a package of lots in the same state. I recommend that the FCC simplify the CAF auction by eliminating package bidding. While adding complexity, this feature is only

warranted in settings where complementarities are strong. In the CAF auction, complementarities are rather weak. Moreover, package bidding introduces new gaming strategies, especially for large bidders. Without package bidding, large bidders exercise market power by allowing smaller bidders to win some lots. This is aligned well with the FCC's goal to encourage participation from small bidders. For this reason, I recommend a non-package auction.

Recommendations

My key recommendation is that the FCC's proposed design is more complex than it needs to be to achieve its objectives. Indeed, the excessively complex design would adversely limit competition among participants, which would undermine the goal of a competitive auction and an efficient outcome. Having and encouraging participation among qualified bidders is at the heart of successful auctions. This point has been demonstrated throughout the FCC's 24-year history with auctions.

The simpler design I propose still has the same descending clock format as proposed, yet avoids many complicating features that are apt to discourage participation and favor certain parties, potentially dominant incumbents and others. Three key changes should be made:

- Eliminate package bidding. As in many prior FCC auctions, the clock auction gives bidders ample opportunity to piece together a desirable package of areas, without the complexity and bias inherent in a package auction.
- Eliminate the ability of a bidder to shift its performance tier and latency combination once established in its initial bid. This simplification avoids complex gaming strategies that would otherwise undermine price discovery.
- Adopt a stronger activity rule that only allows switching in a limited number of opening rounds. In the closing rounds, no switching among lots is possible. This rule eliminates parking in the closing rounds and thereby improves outcome discovery. Bidding is simplified and bids are more apt to reflect true costs.

A further benefit of the simpler design is that it will be easier, less costly, and less risky for the FCC to implement than its more complex alternative. I do understand the good intentions behind the complicating design elements. However, the FCC's proposal is needlessly complex and biased in favor of the most dominant incumbents. To best achieve its objectives, the FCC should simplify the auction. Doing so will maximize participation, expand the set of winners, and increase the value created from Connect America Fund support.

Glossary

The following terms are used throughout this document.

Term	Description
Activity rule	The rule that limits what bids a bidder can make in subsequent rounds of a multiple round auction based on the bidder's bids in earlier rounds. The activity rule is intended to avoid bid sniping. The most common activity rule is one based on aggregate activity in the round. A bidder must be active on a certain fraction of eligibility to maintain that level of eligibility in future rounds.
Bid sniping	The tendency to wait until the last instant to place a serious bid, as in an eBay auction. Auctions often have activity rules in place to prevent bid sniping.
Block	A geographic service area over which the winning bidder is obligated to provide the specified service.
CAF obligation	The obligation of a winning bidder to provide broadband service of a specified quality, as well as voice service, in the lot in exchange for payment from the Connect America Fund.
Clock auction	A multiple round auction in which, in each round, the auctioneer announces prices, and the bidders respond with the blocks they desire to serve at the specified prices. Prices then decrease on blocks with excess supply and the process repeats. (Prices for the CAF Auction are specified in terms of percentage below the reserve price.)
Clock auction without switching	A clock auction for many lots in which each lot closes independently. An activity rule requires that offers to serve a lot cannot increase as prices fall. This format is suitable for settings where costs are roughly additive—the cost of serving the package is the sum of the costs of its individual lots (<i>i.e.</i> , the lots are not complementary).
Combinatorial clock auction	A two-stage auction. The first stage is a clock stage in which bidders specify the lots they wish to offer at various prices; the second stage is a supplementary round in which bidders bid on new lots and improve their bids on lots from the clock stage.
Common cost	Model of bidder costs in which packages of items have similar costs to all bidders. Typically, the bidders do not know the exact common cost but rather have an estimate, in which case each bidder is said to face common cost uncertainty.
Complementary blocks	X and Y are complementary blocks (opposite of substitute blocks) if when the price of Y decreases the willingness to supply X decreases. Complementary blocks are typically sold together and are more valuable (less costly) to serve together than they are apart (the sum is greater than the parts). The complementarity may be strong or weak. The value of a package of blocks with strong complementarities is much higher if served by one supplier as a

	package than the sum of values when broken up and served by multiple suppliers. The blocks have weak complementarities if the value of the package is only slightly higher when served together. The level of complementarity between blocks is important in auction design.
Discrete decrements	This phrase is typically used when describing a clock auction. The price in a clock auction falls in discrete decrements if it decreases in discrete steps. For example, the price may fall from \$1.10 to \$1.00.
Dynamic auction	Any auction format that involves multiple opportunities to bid and where some information about the bidding is revealed to the bidders during the auction. An English auction is the most common form of dynamic auction.
English auction (reverse version)	A format for auctioning a single item. Bidders submit successively lower bids for the item, until no bidder is willing to bid lower. The final bidder wins the item, and receives the amount of his final bid.
Exit bid	A bid for a lot at the bidder's exit price for that lot (see exit price).
Exit price	The lowest price that a bidder wishes to accept for a lot. Therefore, the price at which he wishes to <i>exit</i> the auction for that lot.
Gaming	Bidding in an auction in a way that does not truthfully represent the bidder's true cost, but may increase the bidder's chances of a favorable outcome. A good auction design should minimize the possibility of gaming.
Information policy	The policy that determines the information that is revealed to bidders during a dynamic auction. The information revealed might include bid-specific information such as the price of the bid and the identity of the bidder, or aggregate information such as the total number willing to serve a lot at a specified price (supply for that lot).
Lot	A contiguous set of one or more blocks that is the basic item that is bid on. (The FCC proposes that bidders must combine eligible census blocks into a census block group for purposes of bidding.)
Outcome discovery	A feature of dynamic auctions in which information about bidder offers is reported to bidders, giving bidders the opportunity to adjust subsequent bids based on the information. Outcome discovery includes information that is helpful in assessing both the prices and assignment of lots.
Package auction	An auction that allows package bids.
Package bid	A package bid is a bid on a set of lots. In auctions that do not allow package bids, a bidder interested in a set of lots must submit multiple bids for each of the lots, which exposes the bidder to the possibility that only part of the package is won. With package bidding, the bidder can ensure that it wins one of its desired packages. (The FCC proposes to require a package bidder to supply a minimum scale percentage, which indicates the percentage of locations it would serve if it does not win all lots.)
Parking	A strategy in a dynamic auction with an aggregate activity rule of bidding on popular items early in the auction, rather than on items of true interest. The

	intent is to disguise true interest and reduce price impact on items of interest. Parking is an undesirable gaming behavior that undermines outcome discovery, distorting both prices and assignments.
Price discovery	A feature of dynamic auctions in which information about bidder offers is reported to bidders, giving bidders the opportunity to adjust subsequent bids based on the information.
Pricing rule	The rule that determines the price received by the bidder for each lot that it has won.
Reserve price	The maximum price the buyer will pay for a lot. Clock auctions typically start at the reserve price. For purposes of the CAF Auction, the reserve price is established by the FCC's Connect America Model.
Reverse auction	An auction to buy one or more items. Dynamic reverse auctions have descending prices, such as a descending clock auction.
Sealed-bid auction	An auction in which bidders submit bids without receiving any information relating to the bids placed by other bidders.
Second-price auction	A sealed-bid auction in which the lowest bid wins and the winner is paid a price equal to the second-lowest bid. A useful interpretation of this auction is that the bidder pays the highest price that enables the bidder to win.
Service area	A bidder's aggregation of lots, defining a geographic area over which the bidder has a service obligation were he to win the lots.
Clock auction with package bids	A clock auction similar in design to an SMRA. The key difference is that provisional winners are not determined at the end of each round, only the aggregate supply for each item. The auction ends when there is no excess supply for any item. In each round, the auctioneer announces prices and each bidder bids for the lots desired at the announced prices. An activity rule requires bidders to maintain a level of activity throughout the auction that is commensurate with their desired winnings.
Simultaneous multiple round auction (SMRA)	A format for auctioning multiple items, commonly used for auctioning spectrum licenses. The auction is a natural generalization of the English auction, especially useful when buying many related items. The items are auctioned simultaneously in a sequence of rounds. In each round, each bidder can submit bids on any of the items, lowering the provisionally winning bid by at least the bid decrement. The auction ends when no bidder is willing to bid lower on any item. An activity rule requires bidders to maintain a level of activity throughout the auction that is commensurate with their desired winnings.
Spectrum auction	An auction for radio spectrum (bandwidth at specified frequencies in specified regions).
Substitute blocks	X and Y are substitute blocks (opposite of complementary goods) if when the price of Y decreases the willingness to supply X increases.

Substitution	The act of shifting supply across products in response to price changes, increasing the supply of the product that has become relatively more attractive because of the price change.
Supplementary round	A special round that occurs at the end of the clock stage in a combinatorial clock auction. Bidders bid on new packages and improve their bids on packages from the clock stage.
Tacit collusion	Collusion is cooperative behavior among bidders. Bidders collude tacitly if they do not have an explicit agreement to collude but have some shared understanding derived from past or current bidding behavior.
Winner's curse	The insight that winning an item in an auction is bad news about the item's cost, because winning implies that no other bidder was willing to take on the obligation at the winning price. Hence, it is likely that the winner's estimate of cost is an underestimate. Since a bidder's bid is only relevant if the bidder wins, the bidder should condition the bid on the negative information winning conveys about cost. Bidders that fail to condition their bids on the bad news winning conveys suffer from the winner's curse in the sense that they often bid less than realized cost.

References

- Ausubel, Lawrence M., Peter Cramton, Marek Pycia, Marzena Rostek, and Marek Weretka, "Demand Reduction and Inefficiency in Multi-Unit Auctions," *Review of Economic Studies*, 81(4), 1366-1400, October 2014.
- Ausubel, Lawrence M. and Peter Cramton (2004), "Auctioning Many Divisible Goods," *Journal of the European Economic Association*, 2, 480-493, April-May.
- Ausubel, Lawrence M. and Peter Cramton (2011), "Auction Design for Wind Rights" *Power Auctions and Market Design Report for the Bureau of Ocean Energy Management*, August. Available at <https://goo.gl/6uk5Ti>.
- Ausubel, Lawrence M., Peter Cramton, R. Preston McAfee, and John McMillan (1997), "Synergies in Wireless Telephony: Evidence from the Broadband PCS Auctions," *Journal of Economics and Management Strategy*, 6:3, 497-527.
- Ausubel, Lawrence M., Peter Cramton, and Paul Milgrom (2006), "The Clock-Proxy Auction: A Practical Combinatorial Auction Design," in Peter Cramton, Yoav Shoham, and Richard Steinberg (eds.), *Combinatorial Auctions*, Chapter 5, 115-138, MIT Press.
- Brusco, Sandro and Giuseppe Lopomo (2002), "Collusion via Signalling in Simultaneous Ascending Bid Auctions with Heterogeneous Objects, with and without Complementarities," *Review of Economic Studies*, 69, 407-436.
- Cramton, Peter (1995), "Money Out of Thin Air: The Nationwide Narrowband PCS Auction," *Journal of Economics and Management Strategy*, 4, 267-343.
- Cramton, Peter (1997), "The FCC Spectrum Auctions: An Early Assessment," *Journal of Economics and Management Strategy*, 6:3, 431-495.
- Cramton, Peter (2013), "Spectrum Auction Design," *Review of Industrial Organization*, 42:2, 161-190, March 2013.
- Cramton, Peter, Evan Kwerel, Gregory Rosston, and Andrzej Skrzypacz (2011), "Using Spectrum Auctions to Enhance Competition in Wireless Services," *Journal of Law and Economics*, 54, 2011.
- Cramton, Peter and Jesse Schwartz (2002), "Collusive Bidding in the FCC Spectrum Auctions," *Contributions to Economic Analysis & Policy*, 1:1, 1-17.
- Cramton, Peter, Yoav Shoham, and Richard Steinberg (2006), *Combinatorial Auctions*, Cambridge, MA: MIT Press.
- Kagel, John H. and Dan Levin (1986), "The Winner's Curse and Public Information in Common Value Auctions," *American Economic Review*, 76, 894-920.
- Kagel, John H., Dan Levin, and Jean-Francois Richard (1996), "Revenue Effects and Information Processing in English Common Value Auctions," *American Economic Review*, 86, 442-460.
- Klemperer, Paul (2004), *Auctions: Theory and Practice*, Princeton University Press.
- Milgrom, Paul (2004), *Putting Auction Theory to Work*, Cambridge: Cambridge University Press.
- Pagnozzi, Marco (2010), "Are Speculators Unwelcome in Multi-object Auctions?" *American Economic Journal: Microeconomics*, 2:2, 97-131.